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CONSERVATION PRIORITIES, OBJECTIVES, AND ECOSYSTEM ASSESSMENT APPROACH FOR THE ST. ANNS BANK AREA OF INTEREST (AOI)

Figure 1. St Anns Bank Area of Interest within the Scotian Shelf bioregion.

Context

Under the Health of the Oceans Initiative, Fisheries and Oceans Canada (DFO) Science provides advice in support of the establishment and management of Marine Protected Areas (MPAs). On June 8, 2011, the Minister announced St Anns Bank in the Maritimes Region as an Area of Interest (AOI) for potential MPA establishment.

Once an AOI is identified, DFO Science assists with the compilation and review of information on the key ecosystem attributes of the AOI, along with an assessment of potential risks to these ecosystem attributes. This forms the basis of the Ecosystem Overview and Assessment Reports (EOAR), which assist the Department in refining conservation objectives, delineating boundaries, and determining if an Oceans Act MPA is the appropriate management tool for the site. If the St Anns Bank MPA is established, the EOAR will also inform monitoring protocols and strategies, identification of information gaps, and the development of a management plan for the area.

This Science Advisory Report is from a Regional Science Advisory Process of January 25-26, 2012, to Review the Assessment Report and Proposed Conservation Objectives for the St Anns Bank Area of Interest (AOI), Maritimes Region. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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SUMMARY

- Conservation priorities, including representative, important, and sensitive habitats or features; biodiversity hotspots; depleted species; and important functional groups were identified for the St Anns Bank Area of Interest.

- Based on the conservation priorities, the following Conservation Objectives were proposed. It is expected that these will be reviewed and refined with stakeholders, and will depend on the final boundaries of the Marine Protected Area (MPA), should one be designated.

- Conserve, protect and, where appropriate, restore the **habitats** of benthic, demersal, and pelagic species occurring in the St Anns Bank MPA, including the physical, chemical, geological, and biological properties and processes of those habitats, in both the water column and the seabed. Specifically,
  - Conserve, protect, and, where appropriate, restore the identified habitat types (i.e., Inshore Bank, Shelf, and Slope/Channel) in the St Anns Bank MPA as representative examples of Eastern Scotian Shelf habitats.
  - In addition, if not protected as part of the representative habitats above, ensure that distinctive features are not altered or disrupted by human activities to the extent that they no longer have the characteristics that triggered their identification as conservation priorities within the St Anns Bank MPA.
  - Protect the important habitat of priority species.
  - Protect the structural habitat provided by the identified sea pen and sponge concentrations.

- Conserve, protect, and, where appropriate, restore **biodiversity** in the St Anns Bank MPA, including diversity at the community, species, population, and genetic levels, so as to restore and maintain the structure and resilience of the ecosystems in the MPA. Specifically,
  - Support the survival and recovery of depleted species.
  - Conserve, and protect a portion of, the identified area of high fish diversity (i.e., the Slope).

- Conserve, protect, and, where appropriate, enhance the **productivity** of the ecosystems in the St Anns Bank MPA across all trophic levels, including the key trophic groups and the services they provide, so that they are able to fulfill their ecological role within the ecosystem.

- No consensus was reached on the assessment approach, but some suggestions were provided on a way forward, including simplification of the assessment methodology, focus on ecosystem attributes and functional groups (i.e., higher order objectives) rather than on specific species, and validation of the assessment methodology with a small group to build confidence in the reproducibility of the results prior to completion of the assessment.

BACKGROUND

The St Anns Bank Area of Interest (AOI) has an area of approximately 5,100 km^2, and is located east of Cape Breton Island, immediately east of Scatarie Island (Figure 1). The AOI boundary encompasses a major portion of St Anns Bank proper, as well as Scatarie Bank and part of the

western slope of the Laurentian Channel. However, for the purposes of this Science Advisory Report, the whole AOI area will be referred to simply as St Anns Bank.

The goals of the St Anns Bank Marine Protected Area (MPA), should it be designated as one, as determined by DFO Oceans and Coastal Management in the Maritimes Region, would be to:

1. Conserve, protect, and, where appropriate, restore the ecological health (biodiversity, productivity, and habitat) of St Anns Bank;
2. Contribute to the health, resilience, and restoration of the Eastern Scotian Shelf (ESS) ecosystem;
3. Contribute to the recovery and sustainability of commercial fisheries; and
4. Promote scientific research and monitoring to further understand and protect St Anns Bank.

The MPA establishment process requires DFO to complete a number of steps prior to designation, including the development of Ecological Overview and Assessment Reports (EOAR). An Ecological Overview for St Anns Bank was compiled by DFO Oceans and Coastal Management in the Maritimes Region with the help of DFO Science and others, and it is to be published as a DFO Technical Report of Fisheries and Aquatic Sciences. It provides an in-depth description of the ecological features of the AOI, including an overview of the physical and biological oceanography of the site, as well as profiles of common and important species of the St Anns Bank AOI and surrounding region, including their conservation status, vulnerabilities, and overall utilization of the area. The Ecological Overview is intended to provide an information basis for development of Conservation Objectives and an Assessment report. An Assessment report (to be informed by this Science Advisory Report) will guide the development of regulations and an evaluation of the compatibility of human activities with Conservation Objectives, *i.e.* determination of "low impact" activities.

Definitions

Important Summer Habitat: For the purpose of this assessment, important summer habitat for fish is defined as areas with relative biomass in DFO's summer Research Vessel (RV) survey averaging in the 80th percentile and higher over a long term sampling period (Horsman and Shackell 2009).

Protection ("protect"): For the purpose of MPA establishment, protection refers to management actions intended to reduce to the greatest extent possible the risk to a conservation priority from human activities.

Conservation ("conserve"): For the purpose of MPA establishment, conservation refers to a management action intended to minimise the risk to a conservation priority from human activities while allowing for sustainable use or an acceptable level of interaction.

Data Sources

Analysis of conservation priorities was based primarily on DFO summer RV surveys, halibut longline surveys, snow crab trawl surveys, and 4Vn sentinel (longline) surveys. A number of other data sources were also considered, including benthic sampling in the AOI, bird observations carried out by Canadian Wildlife Service, bathymetric information collected by the Canadian Hydrographic Service, and oceanographic information collected through the Atlantic Zonal Monitoring Program. Data sources and how they were considered are described in the Ecological Overview of St Anns Bank.

ASSESSMENT

Proposed conservation priorities, objectives, and a risk assessment approach for the St Anns Bank AOI were prepared and presented by DFO Oceans and Coastal Management in the Maritimes Region. These were reviewed at a Regional Science Advisory Process on January 25-26, 2012. The following text reflects the conclusions of the review.

Conservation Priorities

Conservation priorities were identified based on current knowledge and information provided in the Ecological Overview for St Anns Bank.

Habitat

The following representative benthic habitat types were identified as conservation priorities in the St Anns Bank AOI (Figure 2; based on WWF Canada 2009):
- Inshore Bank: shallower than 100 m.
- Shelf: approximately 100-200 m.
- Slope/Channel: deeper than 200 m.

Additional research is required to further characterize habitats within the AOI, including development of a more detailed habitat classification map and information on habitat use.
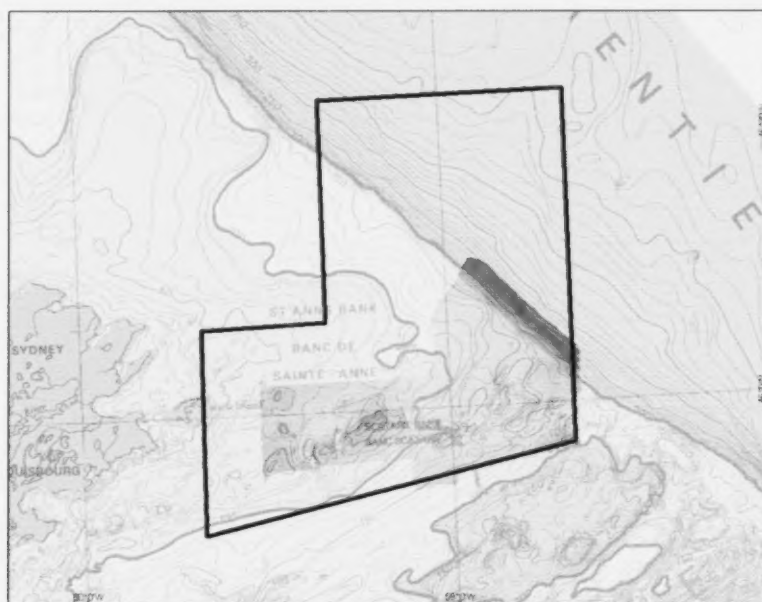

Figure 2. Inshore Bank (light blue), Shelf (green), and Slope/Channel (grey) habitat types within the St Anns Bank AOI [based on WWF Canada 2009], including location of the multibeam bathymetry mapping conducted to date.

The following features (depicted in Figure 3) are thought to be distinctive within the St Anns Bank AOI, but additional research is needed to determine their characteristics (including their extent and role as habitat) and their distinctiveness relative to the rest of the broader bioregion:

- the Big Shoal;
- Scaterie Bank; and
- high relief areas (located on the southern portion of the AOI).

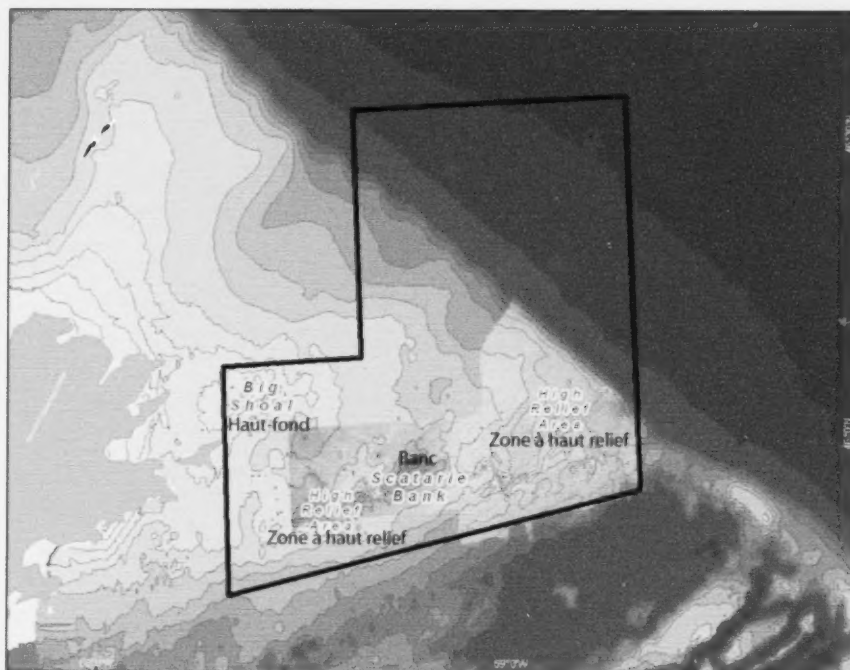Other distinctive features may be determined through habitat mapping and analysis.

Figure 3. General locations of distinctive features within the St Anns Bank AOI.

Important habitat for priority species is considered a conservation priority in the AOI, for example:
- 50% of important summer habitat, as defined in the Background section, for Atlantic wolffish on the ESS is found within the AOI (1994-2006 only) (Figure 4),
- 25% of important summer habitat for Atlantic cod on the ESS is found within the AOI (1994-2006 only) (Figure 5),
- A spawning ground for Atlantic herring (Big Shoal) is found within the AOI.

Figure 4. *Important summer habitat for Atlantic wolffish within the St Anns Bank AOI (1970-2006; Horsman and Shackell 2009).*
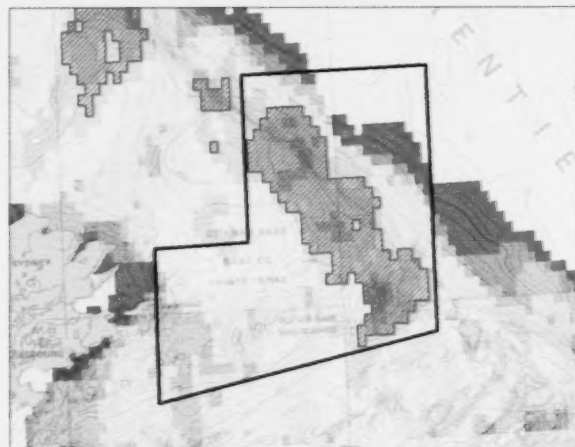

Figure 5. *Important summer habitat for 4Vn cod within the St Anns Bank AOI (1970-2006; Horsman and Shackell 2009).*

Areas with significant concentrations of structure forming species / sensitive benthic species, such as sea pens and sponges (Figures 6 and 7, respectively), were identified as conservation priorities.
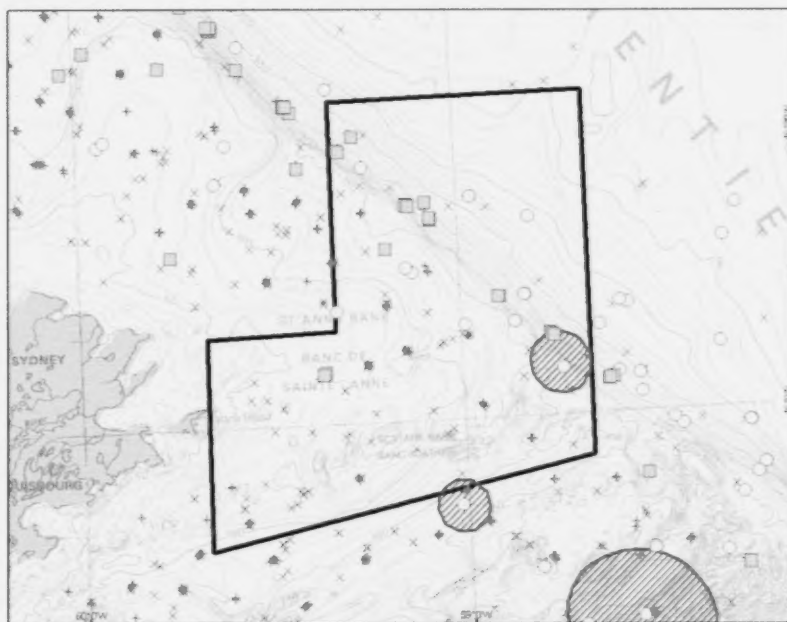

Figure 6. *Sea pen catches recorded in the snow crab survey (green squares; crosses represent sets with no sea pens) and those in the Maritimes Region coral and sponge database (yellow circles, Xs represent records of other taxa in the database). Areas with significant concentrations of sea pens identified by Kenchington et al. (2010) are shown as hatched circles.*
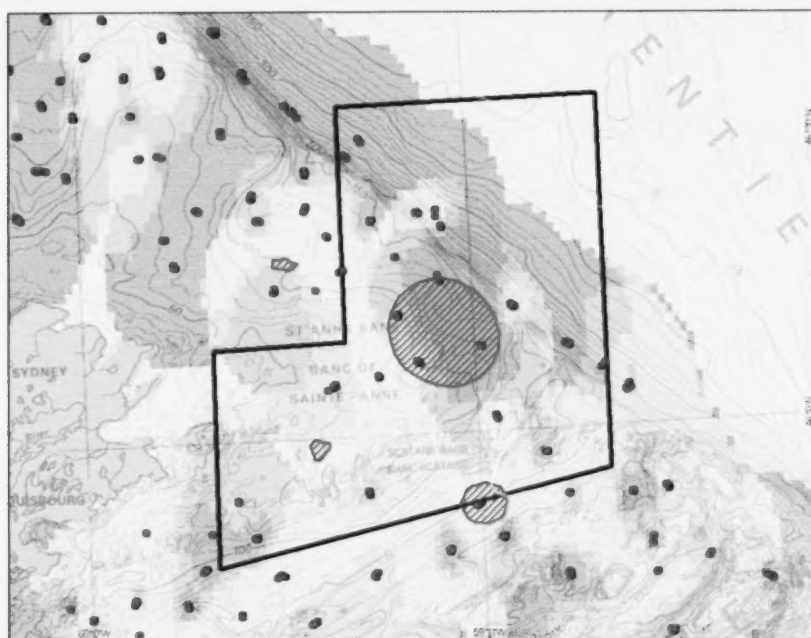
Figure 7. Sponge catches in the snow crab survey (sets locations indicated as red circles) are shown in color, with high catches of sponges in orange and red. Areas with significant concentrations of sponges identified by Kenchington et al. (2010) are shown as hatched circles.

Biodiversity

Fish diversity hotspots were identified as a conservation priority for the St Anns Bank AOI (Figure 8).

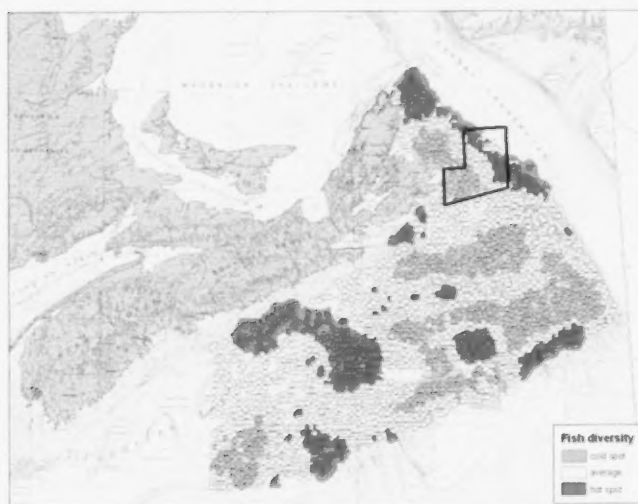Figure 8. Fish biodiversity hot spots (red) on the Eastern Scotian Shelf based on the RV survey. Both the point results from the Getis-Ord hot spot analysis and the interpolated surface are shown. As Z scores are either statistically significant or not, only three colours are used: red (statistically significant hot spot), blue (statistically significant cold spot), and yellow (not statistically significant).

Depleted species (and their important habitats or life-history processes within the AOI) were identified as conservation priorities for the St Anns Bank AOI. Including, but not exclusively:

- Atlantic cod
- Atlantic wolffish
- Porbeagle shark – specifically, because the AOI is part of a larger mating ground for porbeagle shark
- Leatherback turtle – specifically, any area within the AOI that may be identified as critical habitat

Productivity

A balanced or healthy trophic structure was identified as a conservation priority for the St Anns Bank AOI. Important functional groups include,

- Primary producers, including foliose red algae
- Zooplankton, particularly *Calanus finmarchicus*
- Benthic invertebrates (mobile and sessile)
- Forage fish, such as herring and mackerel
- Demersal fish, including cod, other gadoids, flatfishes, and redfish
- Top predators, such as sharks, whales, and seabirds

The relative role of each of these species in the MPA would depend on the final boundaries.

It is recommended that conservation priorities related to seabirds, particularly those that nest on Scaterie Island and feed within the AOI (such as Leach's Storm-petrels), be developed in partnership with Canadian Wildlife Service.

Conservation Objectives

Taking the preceding conservation priorities and their rationales into account, the following Conservation Objectives were proposed for consideration in the next steps of the St Anns Bank MPA planning process:

Habitat

Conserve, protect and, where appropriate, restore the habitats of benthic, demersal, and pelagic species occurring in the St Anns Bank MPA, including the physical, chemical, geological, and biological properties and processes of those habitats, in both the water column and the seabed.

Specifically, conserve, protect, and, where appropriate, restore the identified habitat types (i.e., Inshore Bank, Shelf, and Slope/Channel as defined in the conservation priorities) in the St Anns Bank MPA as representative examples of Eastern Scotian Shelf habitats.

In addition, if not protected as part of the representative habitats above, ensure that distinctive features are not altered or disrupted by human activities to the extent that they no longer have the characteristics that triggered their identification as conservation priorities within the St Anns Bank MPA. Some potential examples of distinctive features are listed below:
- the Big Shoal;
- Scaterie Bank; and
- high relief areas (located on the southern portion of the AOI).

Protect the important habitat of priority species, for example:
- Atlantic wolffish
- Atlantic cod
- Atlantic herring

Protect the structural habitat provided by the identified sea pen and sponge concentrations.

Biodiversity

Conserve, protect, and, where appropriate, restore biodiversity in the St Anns Bank MPA, including biodiversity at the community, species, population, and genetic levels, so as to restore and maintain the structure and resilience of the ecosystems in the MPA.

Specifically, support the survival and recovery of depleted species, including but not exclusively:
- Atlantic wolffish
- Atlantic cod
- Leatherback turtle
- Porbeagle shark

Conserve, and protect a portion of, the identified area of high fish diversity (i.e., the Slope).

Productivity

Conserve, protect, and, where appropriate, enhance the productivity of the ecosystems in the St Anns Bank MPA across all trophic levels, including the key trophic groups and the services they provide, so that they are able to fulfill their ecological role within the ecosystem.

The key trophic groups include:
- Primary producers, including foliose red algae
- Zooplankton, particularly *Calanus finmarchicus*
- Benthic invertebrates (mobile and sessile)
- Forage fish, such as herring and mackerel
- Demersal fish, including cod, other gadoids, flatfishes, and redfish
- Top predators, such as sharks, whales, and seabirds

The Conservation Objectives that result from the advice generated at this advisory meeting should be re-evaluated periodically to ensure that new knowledge on ecosystem functions and the significance of areas and/or species can be appropriately considered.

Knowledge Gaps

Ecosystem services, such as benthic / pelagic coupling and nutrient cycling, are important characteristics of marine ecosystems. However, additional information is required to describe the nature of ecosystem services provided by St Anns Bank. Research that improves our understanding of the core processes and structures that support the integrity and resilience of the St Anns Bank ecosystem is encouraged. Research on the connectivity between the St Anns Bank and the surrounding ecosystem is also encouraged.

While cetaceans were identified as a potential conservation priority, particularly depleted cetacean species, not enough is known about the use of St Anns Bank by these species relative

to the surrounding areas to identify them as a conservation priority for St Anns Bank at this time. Additional research, such as dedicated surveys, is recommended.

While the importance of genetic diversity to ecosystem resilience was recognized, and several species are considered likely to have sub-populations within the area (e.g., whelk), additional research would be required to identify the genetic diversity of any particular species as a conservation priority for St Anns Bank.

Completion of multibeam bathymetry, analysis, and additional field sampling is needed to identify additional distinctive features of St Anns Bank and develop a more detailed habitat classification map.

Improved understanding of the vulnerability of species within the St Anns Bank (including vulnerable life-history traits, such as low reproductive rate) would help inform the impact assessment and future management options.

Assessment Approach

To complete the Assessment Report for the St Anns Bank AOI, there are a number of different ecological risk assessment approaches that could be applied. The proposed approach focused on establishing the risk of interaction between the conservation priorities and Conservation Objectives identified above with a suite of human activities. Activities will be considered in the Assessment Report if they currently occur within the AOI, or there is demonstrated interest in pursuing these activities in the area in the near future.

Human Activities to be Considered in the St Anns Bank AOI Assessment

Fishing
       Snow crab pot
       Lobster pot
       Otter trawl (e.g., for redfish and potentially cod)
       Redfish midwater trawl
       Groundfish seine
       Halibut longline
       Herring or mackerel gillnet
Oil and gas
       Seismic
       Drilling (exploratory or production)
Shipping
       Transit
       Ballast water exchange
Other
       Recreation and tourism
       Research surveys
       Debris (garbage, persistent litter)

For this Assessment, it is proposed that risk be described in terms of likelihood and consequences of the interaction based on a qualitative, but criteria-based, evaluation of available information (Fletcher 2005; Hobday et al. 2011). The method is being proposed for St Anns Bank because it can be applied to a wide range of interaction types with different levels of data availability.

Interactions Matrix

An example of an interactions matrix that reflects the potential interactions between Conservation Objectives and human activities is provided in Appendix 1. These, or a subset, are the type of interactions that would be considered in the evaluation of risk.

The details of the interaction matrix were not reviewed at this meeting, but some general guidelines on the approach were proposed. Specifically, it was felt that the scoring of "quality of information" should have fewer categories (e.g., Table 1) than originally proposed.

Table 1. Information quality scores for interactions identified in Appendix 1.

Score	Information Quality
1	No relevant information could be found.
2	Data from other areas or similar pressures, and poorly understood in those contexts.
3	Data from other areas or similar pressures, but well understood in those contexts **or** Small amount of data from this area and pressure.
4	Good data, which is based on this area and pressure.

Likelihood

It is proposed that likelihood scores be assigned to indicate the probability that the consequence would occur. In some cases, it may be possible to determine this score quantitatively, or a judgment of the most appropriate score can be made based on the information available. It is proposed that the quality of information on each potential interaction be recorded (Table 1), which can be used as an indicator of the level of uncertainty around the likelihood score. This level of uncertainty can be taken into account when determining appropriate management measures.

While there was no consensus on the exact likelihood criteria or scoring that should be used, some guidance was provided. Specifically, likelihood criteria should be very clearly defined, including the timeframe (e.g., the likelihood of a reasonable worst case scenario occurring within some defined timeframe). Reproducibility of results (evaluated through testing) would increase the confidence in the final risk score. Alternatively, the range of scores could be used as a measure of uncertainty.

It was recommended that the scoring be kept very simple (e.g., high, medium and low only). Assigning numerical scores may not be useful for most interactions.

Consequence

It is proposed that consequence scores be well defined. Examples of criteria for assigning consequence scores are provided in Table 2. Time for recovery from any consequence should be considered.

Table 2. Example Consequence Criteria by Conservation Objective.

Consequence Level	0	1	2	3	4	5
Consider for all categories	Change within natural variability	Rapid recovery if activity stopped	Recovery measured in months	Recovery measured in years	Recovery measured in decades	Recovery period many decades
Productivity						
Target species	Undetectable change	Exploitation low	Exploitation moderate	Full exploitation at target biomass	Overexploited - reproductive capacity impaired	Local extirpation
Biodiversity						
Depleted Species	Change within natural variability	Small impact but no change in species recovery	Minor impact on species recovery	Moderate impact on species recovery	Severe impact with species recovery halted	Causing species to decline
Ecosystem level	Change within natural variability	Small changes to abundance of some non-keystone species	Change limited to minor species in ecosystem	Measurable change in ecosystem without major change in functions	Major change in ecosystem structure and function	Collapse of local ecosystem
Habitat						
Activities other than fishing[1]	<1% of habitat impacted	1-10% of habitat impacted	11-40% of habitat impacted	41-60% habitat impacted	61 – 90% of habitat impacted	>90% of habitat impacted
(all fishing activities; from ERAF)		Gear is not known to interact with the seafloor under normal operations.	Gear is known to have minimal interaction with the seafloor as part of normal operations.	Gear is known to interact with seafloor regularly as part of normal operations. Area of impact is roughly equal to the size of the gear itself, i.e. fixed gear.	Gear is known to interact with seafloor regularly as part of normal operations. Area of potential impact is sig. larger than the gear, i.e. mobile gear.	

[1] Change in scaling of habitat impacts is recommended. These are for example only.

The following guidance was proposed to support further development of these criteria:
- Change the criteria associated with the habitat impacts of activities other than fishing to lower the threshold for each consequence level.
- Incorporate DFO guidance on the Precautionary Approach framework into the criteria related to the productivity of target and depleted species. Ensure that criteria related to depleted species considers current DFO policy and science guidelines.
- Use simplified qualitative evaluation in data poor situations, allowing for more detailed information collection and evaluation where the data exists.
- Need to develop new criteria for consequences to productivity, to align with recommended conservation priorities related to productivity.

Risk Scoring

It is proposed that risk be evaluated as the multiplication of the likelihood and consequence scores. For the purposes of illustration, an example risk matrix is provided below (Figure 9). Risk scoring will help guide decisions about how activities will be controlled within the MPA.

Consequences

		Low	Medium	high
Likelihood	low	Low	Low	medium
	medium	Low	Medium	high
	high	medium	High	high

Figure 9. Example risk matrix.

Next Steps

Because this approach to the evaluation of risk is qualitative and relies on judgement about a wide range of interactions, peer review or other group processes are often used to determine or validate the evaluation (Fletcher 2005; Hobday et al. 2011). Hobday et al. (2011) emphasize the importance of involving a range of stakeholders. For the St Anns Bank AOI, scientific expert opinion will be sought to confirm the interpretation of data used to evaluate likelihood and consequence for each interaction. Through the Stakeholder Advisory Committee that will be formed in spring of 2012, and other opportunities, stakeholders will be involved in reviewing the application of the risk assessment model in the design of the MPA.

Sources of Uncertainty

There are some important limitations in the datasets used to determine conservation priorities in the AOI. For example, there has been little directed sampling for plankton in the AOI. Benthic sampling has also been limited, with most sampling conducted during annual DFO research surveys, especially in the northern half of the AOI. These surveys do not sample the full range of habitats in the site (neither the very deep or very shallow), and they do not sample smaller benthic invertebrates or identify all invertebrates to species. Winter sampling is another general gap. Even the surveys with the most extensive coverage, such as the 4Vn sentinel survey, have only covered a very small percentage of the AOI. There are no comparable systematic surveys for cetaceans or seabirds in the area of the AOI, and there is little data on these groups in the area.

For trophic groups composed of individuals that are highly mobile relative to the scale of the MPA, achievement of the productivity objective requires that population-wide biomasses and size compositions be maintained at levels consistent with the ecosystem target. Regulating human activities within the MPA will not, in general, have significant effects on the biomasses or size compositions of highly mobile populations. Their restoration and maintenance will, therefore, depend on management actions outside the MPA's boundaries.

CONCLUSIONS AND ADVICE

Conservation priorities, including representative, important, and sensitive habitats or features; biodiversity hotspots; depleted species; and important functional groups were identified for the St Anns Bank Area of Interest. Based on the conservation priorities, a series of Conservation Objectives were proposed. It is expected that these will be reviewed and refined with stakeholders, and will depend on the final boundaries of the Marine Protected Area (MPA), should one be designated.

No consensus was reached on the assessment approach, but some suggestions were provided on a way forward, including simplification of the assessment methodology, focus on ecosystem attributes and functional groups (i.e., higher order objectives) rather than on specific species, and validation of the assessment methodology with a small group to build confidence in the reproducibility of the results prior to completion of the assessment.

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WWF Canada. 2009 An Ocean of Diversity: the Seabeds of the Canadian Scotian Shelf and Bay of Fundy. WWF Canada, Halifax, Canada. 24 p.

Appendix 1. Potential for interaction between conservation priorities and activities in St Anns Bank. Blue shading indicates a known potential for interaction (information scores 3-4), green shading indicates an interaction that may exist, but with very little information (information scores 1-2), white cells indicate no potential for interaction, and grey shading indicates that further development is required.

	Snowcrab pots	Lobster pots	Groundfish otter trawl	Groundfish midwater trawl	Groundfish danish seine	Halibut bottom longline	Herring / mackerel gillnet	Seismic	Drilling	Transit	Ballast water exchange	Recreation / Tourism	Research surveys	Debris
Habitat														
Inshore bank habitats														
Shelf habitats														
Slope/channel habitats														
Sponge concentrations														
Seapen concentrations														
Distinctive habitats (tbd)														
Preferred and important habitat for species (tbd)														
Biodiversity														
Fish diversity hotspot														
Depleted species														
Atlantic cod														
Atlantic wolffish														
Atlantic redfish														
American plaice														
Porbeagle														
Leatherback turtles														
Productivity														
Primary producers														
Zooplankton														
Benthic invertebrates														
Planktivorous fish														
Demersal predatory fish														
Top predators														

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